Land Transport Authority

Factsheet for Singapore Next-Gen Road Pavement

1. OVERVIEW

1.1. LTA is responsible for the stewardship of over 9,500 lane-km of roads, serving as a common corridor for vehicular traffic, road construction and utility services. Over the years, LTA has explored innovative materials to enhance the performance of our asphalt wearing course, such as reclaimed asphalt pavements (RAP), warm mix asphalt (WMA) and processed plastic waste to improve the durability of our roads in a sustainable way.

1.2. While the focus has predominantly been on enhancing the performance of the topmost pavement layer, there is a growing need to broaden the research to encompass the overall road pavement structure layers, from the subgrade to the surface/wearing course.

1.3. The need mainly arises from (i) the advancement of pavement design method to be based on mechanistic-empirical approach and; (ii) also anticipates future challenges related to climate change, future transport needs, and the complexities of the material supply chain. Therefore, it is timely to perform a comprehensive pavement design review based on the latest design methodologies to improve resilience against climate change and future transport needs, as discussed below.

- **Climate Resilience:** The third National Climate Change Study (MSS, 2024) forecasts more extreme weather for Singapore, including increased rainfall and higher temperatures. The unprecedented temperatures of 2023 and escalated rainfall events (CNA, 2023) have led to more frequent weather-related pavement damage, underscoring the need for a pavement structure that is both sustainable and resilient to maintain road integrity.
- **Future Transport:** With the transition from internal combustion engines (ICE) to electric vehicles (EVs), changes such as increased loading and regenerative braking necessitates an adaptation in road pavement design to meet the evolving needs of the growing EV ecosystem. Additionally, changes in traffic numbers and their associated loadings in the future must be considered.

- **Material Supply Chain:** Singapore heavily relies on imported materials from various countries and regions for road construction, including critical raw materials like granite aggregates and bitumen. The supply chain faces challenges that could impact sustainability and efficiency. Therefore, it is crucial to explore innovative and sustainable technologies and methodologies tailored to local context and applications.

2. SCOPE

2.1. LTA is launching a grant call to seek proposals to develop a holistic road pavement system overlooking for two distinct pavement structure types:

- Expressways and non-expressways roads (i.e., major arterial roads/ industrial roads)
- Busy road junctions/bus bays, where the current standard is rigid concrete pavement.

2.2. Proposal submitted must be able to address both focus areas listed below.

Focus Area (A): Develop durable pavement structures for expressways and non-expressways.

Challenges & Current Situation	Currently, different road categories present a unique maintenance challenge. For instance, industrial roads are subjected to heavier vehicular loading, which can cause faster deterioration of pavement condition. Similarly, expressways, which support high-speed traffic with large volume of vehicles, face different types of maintenance challenges as well. To address these diverse needs, it is envisioned that each road category to be designed suited to its traffic and weather conditions and local maintenance practices.
Possible Solutions (but not limited to)	This call seeks to invite proposals for the development of alternative pavement design, material, and method for different road categories. Research efforts could include (but not limited to) a review on the overall pavement structure, conduct numerical simulations forecasting climate & traffic scenarios, study of local inputs, laboratory exploration of structural, functional and durability performance, conduct accelerated test and field monitoring to verify the performance under designed loading and weather conditions. The proposed solution should consider the practicality of implementation, given the constraints of our existing road network

	system, such as existing ground condition, the overall fixed pavement thickness and limited lane closure hours. This includes proposing solutions for (but not limited to) a) new road constructions & full-depth reinstatement which involves all structural layers, and; b) regular maintenance resurfacing works which typically only involves replacement of asphaltic wearing and base course.
Requirements	<u>Key Performance Requirements</u> • The durable pavement structure proposed should have at least **20% improvement lifecycle cost (LCC) assessment**. • Utilise optimum amount of recycled/sustainable material (e.g., reclaimed asphalt pavement (RAP), recycled concrete aggregate (RCA), bio-bitumen, etc) without compromising on desired pavement performance and environmental aspect. <u>Other requirements</u>: • Demonstrate the new mixes for surface/asphaltic wearing layer have equal or improved pavement performance in terms of safety and functional parameters (skid resistance, riding quality), tyre-pavement noise, and albedo properties as compared to existing pavement types and mixes. • Propose and perform numerical analysis, lab tests and; field accelerated tests and monitoring to provide measurable outcomes that meet objectives of the study. • As wear and tear process may affect the performance of surface/asphaltic wearing course in terms of safety/skid resistance and tyre-pavement noise, propose and adopt cost-effective maintenance intervention to maintain minimum performance of these parameters throughout the lifespan of road surface layer. This could be done through, but not limited by adopting specific design or materials or/and applying rejuvenation coatings, etc. • Conduct carbon footprint assessment and lifecycle cost analysis of the proposed solutions. • Demonstrate the solution's commercial viability, prepare maintenance guidelines and SOP and industry readiness.

Focus Area (B): Develop a pavement structure for road junctions/bus bays.

Challenge & Current Situation	Today, our current pavement structure for high stress sections of the roads (i.e., road junctions/bus bays) is constructed using rigid pavement. However, the construction process of rigid pavement is time-consuming taking around 5-7 days to complete presently. This results in inconvenience to motorists as the road or lane will have to be closed during the works. The study is looking at a pavement structure which can significantly improve the construction productivity for bus bays and road junction, where the current LTA practice is rigid pavement.
Possible Solutions (but not limited to)	This call seeks to invite proposals for the development of alternative pavement design, material, and method for road junction and bus bays. Research efforts could include (but not limited to) exploration of alternative materials or construction process to achieve improved construction productivity while maintaining similar structural properties relative to the current LTA rigid pavement. The proposed solution should consider the practicality of implementation, given the constraints of our existing road network system, such as existing ground condition, the overall fixed pavement thickness and limited lane closure hours.
Requirements	Key Performance Requirements • The proposed pavement structure should have **at least 50% improvement construction productivity** as compared with current LTA rigid pavement. • Innovate through material exploration/process changes to shorten construction time. • Utilize optimum amount of recycled/sustainable material (e.g., recycled concrete aggregate (RCA) etc) without compromising on desired pavement performance and environmental aspect. Other requirements: • Demonstrate the new mix has equal or improved pavement performance in terms of safety and functional parameters (skid resistance, riding quality), tyre-pavement noise, and albedo properties as compared to existing pavement types and mixes. • Propose and perform numerical analysis, lab tests and; field accelerated tests and monitoring to provide measurable outcomes that meet objectives of the study.

	• As wear and tear process may affect the performance of surface/asphaltic wearing course in terms of safety/skid resistance and tyre-pavement noise, propose and adopt cost-effective maintenance intervention to maintain minimum performance of these parameters throughout the lifespan of road surface layer. This could be done through, but not limited by adopting specific design or materials or/and applying rejuvenation coatings, etc. • Conduct carbon footprint assessment and lifecycle cost analysis of the proposed solutions. • Demonstrate the solution's commercial viability, prepare maintenance guidelines and SOP and industry readiness

3. EVALUATION CRITERIA

3.1. Proposals will be selected and evaluated based on the criteria below,

i) Ability to fulfil requirements and KPIs for both Focus A and B.
ii) Cost effectiveness and practicality of implementation of proposed solutions.
iii) Project time effectiveness of proposed solutions.
iv) Proposals that do not fulfill all project scopes will not be considered.

4. ELIGIBILITY CRITERIA AND APPLICATION PROCESS

4.1. This call is open to all R&D organisations in Singapore including publicly funded institutes of higher learning (IHLs), not-for-profit research institutions, public sector agencies, private companies, and company-affiliated research entities.

The Lead Principal Investigator (PI) and Co-Lead Principal Investigator (Co-PI), who are responsible for delivering the outcomes of the project, will be required to have minimum 9 months of residency per year in Singapore. International parties can participate in the project as Collaborators. All work must be done in Singapore, unless expressly approved by the LTA.

4.2. Interested applicants should submit proposals to LTA_innovate@lta.gov.sg by **28 Feb 2025 (Friday), 1700hrs.** Only documents in **Word**, **Excel** and **PDF** formats should be submitted.

5. PROPOSAL GUIDELINES

5.1. Proposals should cover the objectives, proposed approach and project execution plan. This would include proposing methodologies to develop new pavement design, materials, and methods of pavement structures to fulfil both Focus Area A and B, scaling up implementation plans after project completion.

5.2. The guideline for drafting the proposal can be found in the documents for information section under Urban Mobility Innovation (UMI) Initiative, UMI Grant Call – Next Gen Pavement on Land Transport Innovation Portal (LTIP) page.

5.3. Proposals that provide cash or in-kind contributions will be viewed favourably. Multi-disciplinary/organisation teams or teams with industry collaborators are also encouraged to perform holistic analysis and facilitate downstream commercialisation and deployment of R&D technologies developed. Proposals which involve a trial or pilot and include plans for scale-up are preferred. Where applicable, technology readiness level (TRL) of the proposed technology should be at least TRL 5 (prototype demonstration in a relevant environment) and above at the end of the project. Appendix 1 shows the definitions of the TRLs.

5.4. The following may be rejected without review:

- Late or incomplete proposals (including proposals that do not follow the guidelines)
- Proposals that do not fall within the scope of the grant call
- Duplicates of proposals submitted to any other funding agencies for simultaneous consideration
- Ineligibility of the Investigators or R&D organisation

5.5. Submission of proposals to LTA shall be construed as consent by the applicants to participate in the evaluation process. Selection of reviewers is at the sole and exclusive discretion of LTA. LTA shall not be liable for the release of information concerning proposals to third parties by individuals involved in the evaluation process.

5.6. LTA may require proposals to be revised or combined as it sees fit to enhance outcomes, facilitate integration of approaches, and optimise funding resources. LTA's funding decision will be final.

6. FUNDING SUPPORT

6.1. The general level of funding support for approved qualifying direct and indirect[1] for different research performers is elaborated in the below. A list of non-fundable direct cost items can be found in the documents for information section under Urban Mobility Innovation (UMI) Initiative, UMI Grant Call – Next Gen Pavement on Land Transport Innovation Portal (LTIP) page.

Category of Research Performers	Support for Qualifying Direct Costs	Support for Indirect Costs
Institute of Higher Learning (IHLs), not-for-profit research institutions	100%	30%
Singapore-based Small and Medium-sized Enterprises (SMEs[2]), start-ups and not-for-profits	70%	-
Singapore-based Large Local Enterprises (LLEs)	50%	-
All non-Singapore entities based in Singapore (including non-Singapore not-for-profit)	30%	-

6.2. Funding support will be up to two years. Deliverables are expected to be commensurate with the level of funding requested. Funding support will be based on achievement of milestones in a payment schedule.

7. CONTACT INFORMATION

7.1. For further enquiries on this Open Call, please email LTA at LTA_Innovate@lta.gov.sg.

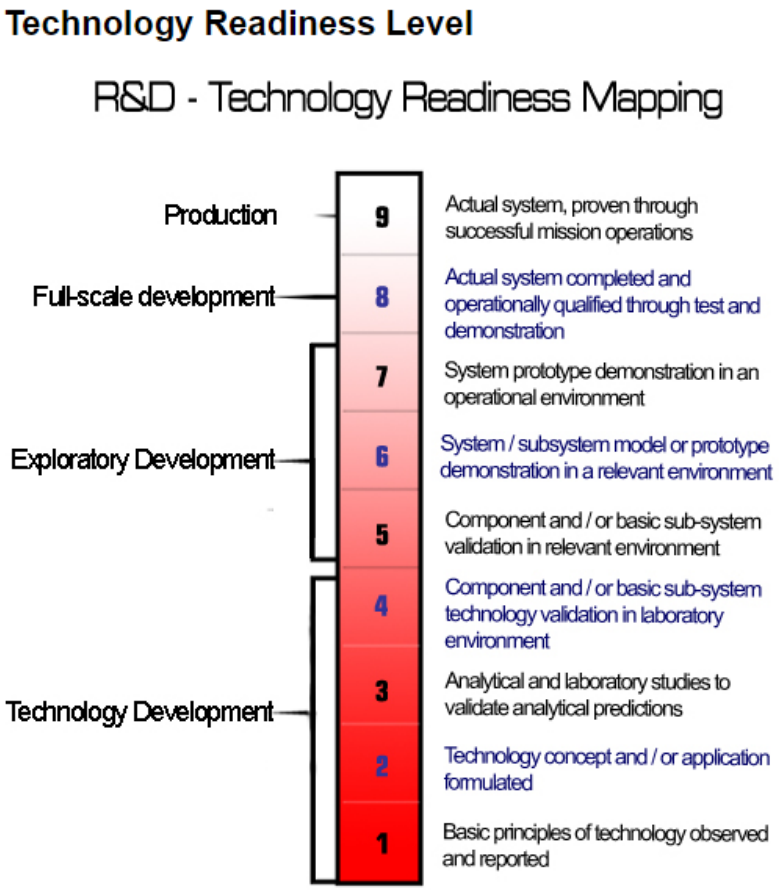
1.1.

[1] Indirect costs are costs that are incurred for common or joint objectives and therefore cannot be identified readily and specifically with a particular project, but contribute to the ability of the research performers to support projects (e.g. providing space, financial administration, utilities).

[2] SMEs refer to entities having a Group Annual Sales Turnover of not more than $100M, or maximum employment of 200 employees.

Appendix 1: Technology Readiness Level Chart

A progressive approach, depending on the Technology Readiness Level (TRL) at the point of decision, is used to evaluate test-bedding of new mobility concepts.



<u>Prototype demonstration in a relevant environment (for TRL 5 & 6)</u>
A technology of interest has demonstrated potential to meet certain transport objectives. It will then be pursued for further development at the component level and subsequently tested for operational viability within confined test areas that mimic part of an envisaged operational environment.

<u>Proof-of-Concept (POC) demonstration in an operational environment (for TRL 7)</u>
If a technology of interest has been proven its potential at the component level, its development will be further pursued. In this case, the test-bedding environment will be escalated into the actual operational environment with actual interaction with other road users and commuters. At this stage, we will focus on evaluating the proposed mobility concept, which deploys the technology of interest, for its envisaged benefits and values in meeting the transport objectives.

Full Scale Deployment (FSD) (for TRL 8 & 9)

This level will be considered after a successful Proof-of-Concept (POC) demonstration. However, it may not be a straight-forward process as other considerations like commercial viability, operational sustainability, and other policy considerations (especially when the new mobility concept could be disruptive to existing modes of travel).